

Technological and Pedagogical Content Knowledge of Nigeria Servicing Science Teachers' Competency in Teaching Profession in Senior Secondary Schools in Ondo-State

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Abstract

This study investigates technological and pedagogical content knowledge of science teachers' competency in teaching profession in senior secondary schools in Ondo State. A survey research design was used on 628 science teachers and 132 principals in 12 local government areas across the three senatorial districts of Ondo State using multistage sampling procedure. Technological and Pedagogical Content Knowledge Questionnaire (TPCKQ) and Science Teachers Profession Competency Questionnaire (STPCQ) were used to collect data. The findings revealed that male science teachers possessed higher PCK than female teachers, urban science teachers possessed higher PCK than the rural teachers, female science teachers display high level of self-efficacy in the use of technology than male counterpart, the levels of TK of urban science teachers are higher than rural respondents, a significant relationship between science teachers' professional competency and their PCK and no significant relationship between the teachers' TK and their professional competency. It is recommended that teachers should focus on the synergy between pedagogy and technology and how it can be implemented within specific content areas. Also, government should equip schools with ICT facilities to enhance integration of technology in science classroom.

Keyword: technological, pedagogical, content knowledge, servicing, science teachers, teaching, profession

Introduction

Teachers' primary role of transmission of knowledge and skills is never in dispute and for any meaningful teaching and learning to take place in school will require an effort of a competent teacher to accompany the effort of learners.

Over the past decades, educational planners, policy makers and administrators all over the world have become increasingly concerned about the quality of education provided by the school system. They have come to realize that many meaningful improvements in the quality of education that students receive are highly dependent on the competence of teachers (Olasehinde-Williams, Yahaya & Owolabi, 2018).

Since teachers are responsible for operating educational system, Michael, Maithya and Cheloti (2016) also opined that competency on the part of teacher is beyond only the mastery of knowledge and methods but rather on strong and efficient technological knowledge to enhance their teaching capacities. The teacher must realize that at the heart of good teaching there are three components: content, pedagogy and technology plus the relationship among and between them (Koeler & Mishra, 2009).

Furthermore, teachers do not only need skills in technological knowledge but they need skills to serve as technological leaders and peer adviser so that they can provide support to the educational system as they attempt to keep with the quality and quantity of technology.

The integration of technology into the educational curriculum demands the availability of well-trained teachers with competency in computer operation, programmed production and developing suitable software to complement their pedagogical content knowledge. Akingbemisilu (2015) submitted that Nigeria have fallen behind in science education delivery due to their inability to utilize information communication technology resources. The conventional teaching approach still takes the lead in Nigeria secondary schools.

Teachers' school location and gender also complicate the relationship between pedagogical content and technological knowledge. Rural school environment and management (leadership) are often unsupportive of teachers' effort to integrate technology into their pedagogical content knowledge. (Jeyeraj & Ramnath, 2018; Karaca, 2015; Roig, Mengual & Quinto, 2015; Jang and Tsai, 2012)

Acquiring a new knowledge base and skills set can be challenging, particularly if it is a time-intensive activity that must fit into a busy schedule. Moreover, this knowledge is unlikely to be used unless teachers can conceive of technology uses that are consistent with their existing pedagogical beliefs. Furthermore teachers in Nigeria have often been provided with inadequate training for integrating technological knowledge into their pedagogical content knowledge, since most of them earned degrees at a time when educational technology was at a very different stage of development than it is today.

Some of the most common reasons teachers give with integrating technology in their teaching practices are lack of time, inflexible school time table, access to technology, non-

availability of technology resources, difficult access to available technology and technical support. In fact, some female teachers are reluctant to use technology for teaching and learning they believed western technology embodies patriarchal values and do not appreciate its value or relevance to teaching and learning.

Considering the evidence reviewed above, it is apparent clear that teachers' play a key role in operating quality educational system with excellent integration of technology. It is on this ground that this study examines servicing science teachers' technological and pedagogical content knowledge in relation to gender, competency and school location.

Purpose of the Study

The purpose of the study was to examine servicing science teachers' technological knowledge and pedagogical content knowledge in relation to gender, school location and teaching competency in the teaching profession. Specifically, the study aimed to:

- (i) find out the level of Pedagogical Content Knowledge (PCK) and Technological Knowledge (TK) of science teachers in Ondo State.
- (ii) find out the relationship between Technological Knowledge (TK) and Teachers' Professional Competency (TPC) of senior secondary school science teachers in Ondo State.
- (iii) investigate the relationship between Pedagogical Content Knowledge (PCK) and Teachers' Professional Competency (TPC) of senior secondary school science teachers in Ondo State.

Research Questions

Answers were sought for the following research questions:

1. What is the level of the pedagogical content knowledge of servicing science teachers based on gender and school location in Ondo State?
2. What is the level of the technological knowledge of science teachers based on gender and school location in Ondo State?

Research Hypotheses

The following hypotheses were formulated and tested for the study:

1. There is no significant relationship between pedagogical content knowledge and science teachers' professional competency.

2. There is no significant relationship between technological knowledge and teachers' professional competency.

RESEARCH METHOD

This study involved the non-experimental design that adopted a descriptive research of survey type. The population for this study comprised all 3,000 male and female science teachers and 304 principals in all government owned senior secondary schools in rural and urban area of Ondo State. A sample of 628 servicing science teachers and 132 principals in the public secondary schools in Ondo State. Multi-stage sampling procedure was used to draw out 760 respondents (both teachers and principals) who participated in the study from all the three senatorial districts: the Central, North and South Districts respectively. The stages involved simple random selection of four (4) local government from the six (6) Local Government Areas (LGA) that make up each senatorial district follow by stratified sampling selection of 11 schools from each local government area selected. The selection of the schools was on the basis of school location (urban and rural). All the science teachers and principals in each selected school constituted the sample for the study.

Instruments, Data Collection and Analysis

Two instruments were used for the study. They include:

1. Technology and Pedagogical Content Knowledge Questionnaire (TPCKQ)
2. Science Teachers' Professional Competency Questionnaire (STPCQ)

TPCKQ adapted from Sahin (2011) which was used by the researcher to measure the level of pedagogical content knowledge and technological knowledge of science teachers. The questionnaire consisted of two sections (A and B). Section A consisted of four items on Bio-data of the participants while section B had 35 items, divided into two sub-sections which were structured into a five point Likert-format of scale. The STPCQ was designed to be filled by principals to obtain information on teachers' job performance and professional competency. The items on the questionnaire were structured on a four point Likert-format scale. The content and face validities of the instruments were ascertained by lecturers in the Department of Science Education, Adekunle Ajasin University, Akungba-Akoko. The reliability coefficients of 0.93 for TPCKQ and 0.84 for TPCQ respectively by subjecting the data obtained from 20 teachers and five principals of secondary schools who were non-participants in the study to Cronbach Alpha. The set of questionnaire were administered by the researcher and 18 research assistants to the selected sample and were collected immediately after responses had been supplied. The data

obtained were analysed using frequency counts, percentages, mean, standard deviation and Spearman Rho correlation analysis.

Results

Research Question 1: What is the level of the pedagogical content knowledge of servicing science teachers in Ondo State in relation to gender and school location?

In answering this question, the data obtained from Pedagogical Content Knowledge section of TPCKQ were subjected to frequency counts and percentages. The scores were distributed as low, moderate and high scores. 1-2 scores were categorized as low; 3 was tagged as moderate; and 4-5 were termed as high. The results are presented in table 1.

Table 1: Level of Science Teachers' PCK Based on Gender and School Location

PCK Levels	Low f (%)	Moderate f (%)	High f (%)	Total
Female	122 (31.1)	257 (65.6)	13 (3.3)	392
Male	42 (17.8)	170 (72.0)	24 (10.2)	236
Rural	80 (29.6)	184 (68.2)	6 (2.2)	270
Urban	85 (23.7)	253 (70.7)	20 (5.6)	358

Result from table 1 shows that the percentage of female servicing teachers who possessed a low (31.1%), moderate (65.6%) and high (3.3%) level of PCK and the male servicing teachers possessed a low (17.8%), moderate (72.0%) and high (10.2%) level of PCK. This indicated that there were more male science teachers in Ondo State with higher level of PCK than the female servicing science teachers. The table also showed that there are higher numbers of urban servicing science teachers who possess high level of PCK (5.6%) than their rural counterpart (2.2%).

Research Question 2: What is the level of the technological knowledge of science teachers' based on gender and school location in Ondo State?

In answering this question, the data obtained from technological knowledge section of the TPCKQ were subjected to frequency counts and percentages. The scores were distributed as low, moderate and high scores. 1-2 scores were categorized as low; 3 was tagged as moderate; and 4-5 were termed as high. The results are presented in table 2.

Table 2: Level of Science Teachers' TK Based on Gender and School Location

TK	Low f (%)	Moderate f (%)	High f (%)	Total
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Levels		(%)		
Female	231 (58.9)	151 (38.5)	10 (2.6)	392
Male	155 (65.7)	81 (34.3)	0 (0)	236
Rural	195 (72.2)	74 (27.4)	6 (0.4)	270
Urban	198 (55.3)	151 (42.5)	9 (2.1)	358

Result from table 2 shows the percentage of female servicing teachers who possessed a low (58.9%), moderate (38.5%) and high (2.6%) level of TK and the male servicing teachers possessed a low (65.7%), moderate (34.3%) and high (0%) level of TK. This indicated that there are more female science teachers in Ondo State who are at high level of TK than the male servicing science teachers. Table 2 also shows that there is lower percentage of urban servicing science teachers who possess low level of TK (55.3%) than their rural counterpart (72.2%) while urban servicing science teachers with moderate level of TK (42.5%) is higher in urban area than in rural area (27.4%).

Research Hypotheses

Hypothesis 1: There is no significant relationship between pedagogical content knowledge and science teachers' professional competency.

In testing this hypothesis, the data obtained from the pedagogical content knowledge session of the TPCCKQ and TPCQ were subjected to Spearman Rho correlation to determine if there is any significant relationship between pedagogical content knowledge and science teachers' teaching competency. The result is presented in table 3.

Table 3: Correlation Analysis of the Relationship between Pedagogical Content Knowledge and Teachers' Professional Competency

Variables	N	R	Sig
PCK	628	0.084	0.036
TPC			

Result from table 3 shows correlation coefficient of 0.084. This low value indicates a weak positive correlation between the teachers' professional competency and their pedagogical content knowledge. This indicated that a unit increase of 0.084 in the levels of the pedagogical content knowledge of the science teachers will automatically make a corresponding unit improvement in the science teachers' professional teaching competency. The *p*-value of 0.036 suggests a significant relationship between the teachers' professional competency and their pedagogical content knowledge.

Hypothesis 2: There is no significant relationship between teachers' technological knowledge and teachers' professional competency.

In testing this hypothesis, the data obtained from the technological knowledge session of the TPCQ and TPCQ were subjected to correlation to determine if there is any significant relationship between teachers' technological knowledge and their professional teaching competency. The result is presented in Table 4.

Table 4: Correlation Analysis of the Relationship Between Teachers' Technological Knowledge and their Professional Competency

Variables	N	R	Sig
TK	628	0.004	0.924
TPC			

Result from table 4 shows that there is a very weak positive relationship between teachers technological knowledge and professional competency, ($r_s = 0.004$ $p < 0.01$) i.e. as the science teachers' professional competence increases, the levels of the technological knowledge will also increase. The p -value of 0.924 suggests an insignificant relationship between the professional competence of the teachers and their technological knowledge.

Discussion

The result of this study shows that male science teachers possessed higher pedagogical content knowledge than female science teachers. The findings of this study support the findings of Roig, Mengual and Quinto (2015) and Liwei and Yen-Jung (2018). The findings contradict the findings of Ahmed (2019).

The result of this study also show that urban science teachers possessed higher pedagogical content knowledge more than the rural science teachers. The result from this study disagreed with the findings of Patra and Guha (2017).

The results show that the female science teachers display high level of self-efficacy in the use of technology than male counterpart. The evidence from this study agrees with the findings of Jang and Tsai (2012) and Karaca (2015) but not in consonant with the findings of Oz (2015) and Roig, Mengual and Quinto (2015).

The study revealed that the levels of technology knowledge of urban science teachers are higher than rural respondents. The result of this study agreed with the findings of Jeyeraj and

Ramnath (2018) not in variance with the findings of Wang, Tegelaar and Admiraal (2019), Fadhil and Rosidah (2020).

The result of this study showed that there was a significant relationship between science teachers' professional competency and their pedagogical content knowledge. This is supported by the findings of Mohalik (2013), Lucenario, Yangco, Punzalan & Espinosa, (2016).

The result of this study further showed that there was no significant relationship between the teachers' technological knowledge and their professional competency. This is supported by the findings of Drent and Meelissen (2008). This result is not in consonant with the findings of Olaolu, Abdulrahman and Habibatu (2012) Rastogi and Malhotra (2013), Michael, Maithya and Cheloti (2016), Palagolla and Wickramarachchi (2019).

Conclusion and Recommendation

From the findings of this study, it was found gender and school locations do influence science teachers' technological and pedagogical content knowledge. It was also found that the higher the level of science teachers pedagogical content knowledge and technological knowledge, the higher their professional competency. Based on the findings, it is recommended that teachers should see the importance of using technology in their professional settings and to focus on the synergy between pedagogy and technology and how it can be implemented within specific content areas. Also, government should equip both the urban and rural public schools with necessary ICT facilities which will enhance integration of technology in science classroom.

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